CLAIMS

1. A semiconductor structure for use in the near infrared region, preferably in the range from 1.3 to 1.6 μm, said structure comprising:

an active zone consisting of a plurality of epitaxially grown alternating layers of Si and Ge,

a base layer of a first conductivity type disposed on one side of said active zone,

a cladding layer of the opposite conductivity type to the base layer, the cladding layer being provided on the opposite side of said active zone from said base layer, wherein the alternating Si and Ge layers of said active zone form a superlattice so that holes are located in quantized energy levels associated with a valance band and electrons are localized in a miniband associated with the conduction band and resulting from the superlattice structure.

2. The semiconductor structure in accordance with claim 1, wherein a dopant material is incorporated into the alternating layers of the active zone so that a doping gradient is realized in the superlattice.

3. The semiconductor structure in accordance with claim 2, wherein at least one barrier layer is provided between a side of said active zone and at least one of said base layer and said cladding layer at which the doping density is highest.

4. The semiconductor structure in accordance with claim 1, wherein the Ge layers of the active zone each comprise a relatively thin layer of germanium material and substantially regularly spaced apart islands of germanium, each island having a relatively greater thickness than said thin layer, said islands forming quantum dots providing said quantized energy levels for said holes.

5. The semiconductor structure in accordance with claim 4, wherein the substantially regularly spaced apart islands of each Ge layer are aligned in the direction of epitaxial growth with the islands of the other Ge layers.

6. The semiconductor structure in accordance with claim 1, wherein the germanium layers each have an average thickness in the range between 0.7 nm and 0.9 nm.

7. The semiconductor structure in accordance with claim 1, wherein said base layer comprises silicon.

8. The semiconductor structure in accordance with claim 1, wherein said cladding layer comprises at least one of silicon, and a metal silicide having a silicon lattice structure.

9. The semiconductor structure in accordance with claim 3, wherein said barrier layer comprises at least one of intrinsic silicon and doped silicon and one of an intrinsic silicon-rich alloy of silicon and germanium and doped silicon-rich alloy of silicon and germanium.

10. The semiconductor structure in accordance with claim 2, wherein the highest doping density in the active zone is about 10^{18} cm^{-3}.

11. The semiconductor structure in accordance with claim 2, wherein the lowest doping density in the active zone is about is 5×10^{16} cm^{-3}.

12. The semiconductor structure in accordance with claim 2, wherein the dopant is one of Sb and P for n-type Si and one of B and In for p-type Si.

13. The semiconductor structure in accordance with claim 1, wherein said active zone comprises at least 12 alternating layers.

14. The semiconductor structure in accordance with claim 1, wherein said active zone comprises not more than 30 alternating layers.

15. The semiconductor structure in accordance with claim 1, wherein said active zone comprises from 15 to 25 alternating layers.

16. The semiconductor structure in accordance with claim 1, wherein the thickness of each silicon layer of said active zone is less than 5 nm.

17. The semiconductor structure in accordance with claim 4, wherein the lateral germanium island density lies in the range of 10^{10} to 10^{11} cm^{-2}.

18. Method of manufacturing a semiconductor structure, the method comprising:

epitaxially growing an alternating sequence of Si and Ge layers on a base layer having the same crystal structure and at least the same lattice constant as Si;

maintaining the temperature of the structure during growth to be in the range of 400°C to 650°C and preferably between 425°C and 550°C;

growing each said Ge layer at a growth rate of from at least 0.02 nm/s to at most 2 nm/s;

growing each Si layer at a growth rate of from at least 0.05 nm/s to at most 4 nm/s;

growing the cladding layer at a rate of from at least 0.05 nm/s to at most 4 nm/s.

19. The method in accordance with claim 18, further comprising;

providing at least one barrier layer between a side of the active zone and at least one of said base layer and said cladding layer at which the doping density is highest.

20. The method in accordance with claim 18 further comprising;

doping the alternating layers of the active zone, wherein a doping gradient is realized in the superlattice.

21. The method in accordance with claim 18 further comprising;

doping the alternating layers of the active zone with one of Sb and P in case of n-type Si and with one of B and In in case of p-type Si, achieving a highest doping density in the active zone of about 10^{18} cm^{-3} and a lowest doping density in the active zone of about 10^{17} cm^{-3}.

22. The method in accordance with claim 18 further comprising:

growing regularly spaced apart islands of germanium in said Ge layers due to inherent stress as a result of lattice misfit of a Ge layer and a Si layer, said islands forming quantum dots providing said quantized energy levels for said holes.

23. The method in accordance with claim 18 further comprising:

using electron photolithography and epitaxial growth for creating regularly spaced apart regions of germanium material on one of a buffer layer and a first Si layer of the active zone, which act as growth seeds for islands of germanium in said Ge layers, said islands forming quantum dots providing said quantized energy levels for said holes.

24. The method in accordance with claim 18 further comprising:

using a nano imprint technique for creating regularly spaced apart indentations, which act as growth seeds for islands of germanium in said Ge layers, said islands forming quantum dots providing said quantized energy levels for said holes.

25. The method in accordance with claim 18 further comprising:

maintaining the temperature of the structure during growth to be in the range of between 425°C and 550°C.